THEORY OF COMPUTATION

SOLUTIONS

1. Let Prefix(u) = {x | u = xy}

Let u be a string of length n. Total number of Prefixes possible for u will be

(a) n
(b) n – 1
(c) n + 1
(d) None

Solution: Option (c)

Explanation:
Ex. u = ab Prefix (u) = {ε, a, ab}

- ⇨ ε.ab
- ⇨ a.b
- ⇨ ab.ε

2. Consider this:

S_1: Language L and its complement $\bar{L}$ will have same number of states in minimal DFA.
S_2: Language L and its complement $\bar{L}$ will have same number of states in minimal NFA.

(a) Both are True
(b) Both are False
(c) $S_1 \rightarrow T$, $S_2 \rightarrow F$
(d) $S_1 \rightarrow F$, $S_2 \rightarrow T$

Solution: Option (c)

Explanation:
Only in DFA, we can say that.

3. Let L be a Finite language in which maximum length of string is n and minimum length is m(m < n). Minimum number of states in the DFA will be:

(a) m + 1
(b) n + 1
(c) n + 2
(d) m + 2

Solution: Option (c)

Explanation:

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In case of finite, maximum n length has to be accepted in n + 1 states and 1 dead state to reject strings of length more than n.

4. Let w be any string of length *n* in (0, 1)*. Let L be set of all sub-strings of *w*. Minimum number of states in NFA that accepts L?

(a) n
(b) n + 1
(c) n + 2
(d) n – 1

Solution: Option (b)

Explanation:
Here $|w_{max}| = n$ and since it's a NFA, no dead state is required. So there should be *n+1* states in the NFA.

5. Consider these:

S_1: Kleene closure of a language is always infinite.
S_2: Concatenation of infinite language and finite language is always infinite.

(a) Both are True
(b) Both are False
(c) $S_1 \rightarrow T$, $S_2 \rightarrow F$
(d) $S_1 \rightarrow F$, $S_2 \rightarrow T$

Solution: Option (b)

Explanation:
For S_1: $\phi^* = \varepsilon$
For S_2: $a^* . \phi = \phi$

6. Let $L = \{x \in \{a, b, c\}^* : x$ contains exactly one *a* and exactly one *b*$\}$.

Which is true?

(a) R. E. = $c^+ a c^+ b c^+ + c^+ b c^+ a c^+$
(b) R.E. = c* a c* b c* + c* b c* a c*
(c) Both (a) and (b)
(d) R.E. not possible as L is context-free

Solution: Option (b)

Because Option (a) does not generate *ab* and *ba* which are in L.

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7. Consider:

S_1: Every regular language can be accepted by NFA with only one Final state
S_2: There is a language for which L = L*

(a) Both are True
(b) Both are False
(c) $S_1 \rightarrow T$, $S_2 \rightarrow F$
(d) $S_1 \rightarrow F$, $S_2 \rightarrow T$

Solution: Option (a)

Explanation:
For S_1: Because of ε-moves
For S_2: L = {ε}

8. If L is Turing-recognizable. Then

(a) L and $\bar{L}$ must be decidable.
(b) L must be decidable but $\bar{L}$ need not be.
(c) Either L is decidable or $\bar{L}$ is not Turing recognizable.
(d) None of above.

Solution: Option (c)

9. S_1: $L \leq_m \{0^n1^n \mid n \geq 0\}$ then L is decidable.

S_2: if L is R.E. and L' ⊆ L then L' is recursively enumerable because enumerator for L also enumerates L'.

(a) Both are True
(b) Both are False
(c) $S_1 \rightarrow T$, $S_2 \rightarrow F$
(d) $S_1 \rightarrow F$, $S_2 \rightarrow T$

Solution: Option (c)

Explanation:
For S_2: Take L = (0 + 1)* which is R.E. and L' = L_d which is not R.E.

Enumerator for L outputs all strings in L' but also outputs strings that may not be in L', So it is not enumerator for L'.

10. Which of the following CFG is not producing the same language as others?

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(a) $S \rightarrow aS \mid bS \mid a \mid b \mid \varepsilon$
(b) $S \rightarrow Sa \mid Sb \mid a \mid b \mid \varepsilon$
(c) $S \rightarrow a \mid b \mid SS \mid \varepsilon$
(d) $S \rightarrow aS \mid b\ A$
$A \rightarrow bA \mid \varepsilon$

Solution: Option (d)

Explanation:
Options (a), (b), (c) produce (a + b)*

11. $L_1 = \{a^m b^n c^p \mid m \geq n \text{ or } n = p\}$
$L_2 = \{a^m b^n c^p \mid m \geq n \text{ and } n = p\}$

(a) Both are NCFL's
(b) L_1 is DCFL and L_2 is NCFL
(c) L_1 is NCFL and L_2 is not context-free
(d) Both are not context-free

Solution: Option (c)

Explanation:
L_2 is CSL.

12. Consider the following Grammar:

$S \rightarrow aS \mid Sb \mid SS \mid \varepsilon$

I. G is ambiguous
II. Language is a*b*
III. G can be accepted by DPDA
IV. r = (a + b)*

Which are true?

(a) i, ii, iii only
(b) i, iii only
(c) iii, iv only
(d) i, iii, iv only

Solution: Option (d)

Explanation:

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Language is (a + b)*

13. $L_1 = \{ca^nb^n\} \cup \{da^nb^{2n}\}$
$L_2 = \{a^nb^nc\} \cup \{a^nb^{2n}d\}$

(a) Both are DCFL's
(b) Both are NCFL's
(c) L_1 is DCFL, L_2 is NCFL
(d) L_1 is NCFL, L_2 is DCFL

Solution: Option (c)

Explanation:
Because of c & d at starting, we can decide how much to pop and push in stack.

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